

REFRACTORIES FOR INDUSTRY

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DEVELOPMENT AND USE OF REFRACTORIES FOR LINING CARS FOR FIRING BUILDING BRICK

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Effective refractory materials for lining the hearths of tunnel furnace cars were developed at Petrokast Silika Co. The cars lined with such refractories have been successfully operating for more than 2.5 years in various enterprises.

Petrokast Silika Co. (previous “Riostal”) supplies refractory articles and dry finished refractory mixtures (concretes) for the country’s metallurgical concerns. In addition, the cumulative experience in selecting refractory materials for extreme conditions of use in metallurgical aggregates allowed obtaining refractories highly recommended as lining for hearths of tunnel furnace cars in roasting of building brick.

This material, brand VCF (vibratory casting fireclay), was supplied to several firms in the construction industry such as Pobeda, Kudinovsk Ceramics Combine, Lenstroik-keramika, Petrokeramika, Zvezda Factory, Neva Ceramics Factory, etc. For a relatively low price, it ensured stability of the car lining at the level of 70–80 cycles.

Since the stability of the lining is also a function of its design to a significant degree, the experiments conducted in this area allowed proposing refractories with several design variants. One such design is shown in Fig. 1. Its advantages include:

- minimum articles of standard sizes used (total of four), i.e., simplicity of assembling the car hearth;
- ensuring uniform loading of all constituent elements;
- relaxation of the significant localized stresses that arise;
- simple and inexpensive maintenance of the car;
- accessible and effective heat insulation in the assembly.

It should be noted that Petrokast Silika Co. has also manufactured linings for cars for Unimoranda, Serik, and Burton at different times. The molds were designed and manufactured independently.

The mineral composition of refractories for car linings was optimized with x-ray, petrographic, and thermogravimetric methods of investigation. Several brands of finished articles for lining cars or dry mixtures for making these items on site are now offered to building brick manufacturers.

The properties of the proposed refractory materials for lining cars and the properties of materials based on hydraulic binders or liquid glass are reported in Table 1.

With respect to the thermomechanical properties, the proposed refractories are much better than traditional materials and allow a longer operating cycle of the car hearth.

The thermal stability was determined at the same furnace temperature (1000°C) for all samples, and the samples were cooled in water. It should be noted that carefully selecting the grain composition of the fillers ensures much lower water requirements and consequently optimum final porosity of the articles, which are functionally correlated with the strength and thermal stability of the proposed materials.

Using the optimized composition of VCF refractory guarantees a minimum of 120 cycles for the car hearth, and the quality is due to the continuous regular backbone of silica tetrahedrons and a glass phase of stable composition in the ceramic binder. The material does not tend to recrystallize and the properties at the working temperatures are worse. The cost is relatively low.

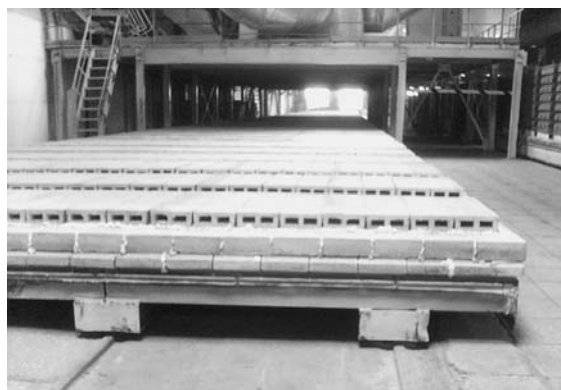


Fig. 1. Car lined with Petrokast Silika Co. refractories.

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TABLE 1

Item	Mass content, %			Water requirements in mixing, %	Density, g/cm ³	Ultimate compressive strength, MPa, at temperature of		Temperature of use, °C	Thermal stability (1000°C – water), thermal cycling
	Al ₂ O ₃	SiO ₂	CaO			100°C	1000°C		
VCF	28 – 32	58 – 62	0.5	9	1.88	25	25	1100	10 – 15
Riokast 50	50	41	3	8	2.01	40	50	1350	15 – 20
Riokast 70	68	12	2.5	6	2.60	50	80	1500	25
Riokast ShL-0.8 (light-weight brick)	28	—	—	15	0.80	3	5	1000	6
Commercial concrete on high-alumina cement	38	45 – 55	7 – 9	12	1.90 – 2.00	30 – 40	20 – 30	1300	5
Concrete on nepheline slurry and liquid glass	28 – 40	40 – 55	1 – 2	15	2.00	20	15 – 17	1000	5 – 7

Use of Riokast 50 refractory ensures the guaranteed operating time at the level of 200 cycles at temperatures up to 1350°C, which also makes it suitable for lining cars for roasting sanitary-industrial articles. Addition of reactive active modifications of silicon and aluminum oxides to the matrix causes formation of needle-shaped concretions of mullite phase along the boundaries of the filler grain with creation of a thermostable, stable, finely crystalline backbone in the binder.



Fig. 2. Stroipolimerkeramika Co. car before overhaul.



Fig. 3. Lining the car – installing side blocks.

A thermostable filler and imported multimodal reactive alumina are also used in Riokast 70 articles and concretes, which ensures an even higher level of consumer properties and temperature of use up to 1500°C.

The decrease in the strength characteristics of cement-based materials during use is due to dehydration of calcium aluminates of different basicity formed in mixing with water. Uncontrollable mullite phase formation from a glass phase of irregular composition in clear deficiency of the glass phase in the working temperature region takes place during roasting, and this worsens the properties of these concretes.

The low performance indexes of materials on liquid-glass binder and nepheline slurry (or other belite-containing materials) are due to recrystallization of calcium–sodium–silicate glasses in the catalytic effect of the initial phases with respect to it.

The highly stable lining materials offered by Petrokast Silika Co. have been used for a long time at Stroipolimerkeramika Co. The company's car fleet was in an unsatisfactory state before the joint effort began (Fig. 2).

Stroipolimerkeramika Co. has molds for casting blocks and Petrokast Silika Co. provides it with the inexpensive VCF mixture. The block manufacturing technology is implemented on site. The process of lining the car is shown in Fig. 3.

As a result of the joint work, the Stroipolimerkeramika cars lined with refractories developed at Petrokast Silika Co. have been operating for 2.5 years (approximately 120 cycles) and continue to operate.

A project for manufacturing lining blocks for brick firing cars (for any customer) made of dry finished mixtures from Petrokast Silika Co. in the company's yards is being developed with Stroipolimerkeramika Co. The example of successful brick production will demonstrate the efficiency and economical effectiveness of the proposed materials.

For brick works interested in organizing such a line on site, Petrokast Silika Co. is ready to deliver experimental lots of the mixture free or manufacturing blocks with an important discount.